UNIVERSITÉ CATHOLIQUE DE LOUVAIN
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Benchmarking Parameters and Controllable Costs

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Outline

Project overview
Data issues
Model structure
Specific challenges
- Dimensionality

Conclusions

Mission

Find models to determine

- *Efficient costs for structurally comparable operators in electricity and gas distribution.*

The modus operandi of the models should be objective, non-disciminatory, and transparent.

Modeling steps

Descriptive statistical models

- Significance test for technically and empirically relevant variables on BNA data

Benchmarking models (ex post)

- Determine best practice performance for the past period using hindsight

Benchmarking models (ex ante)

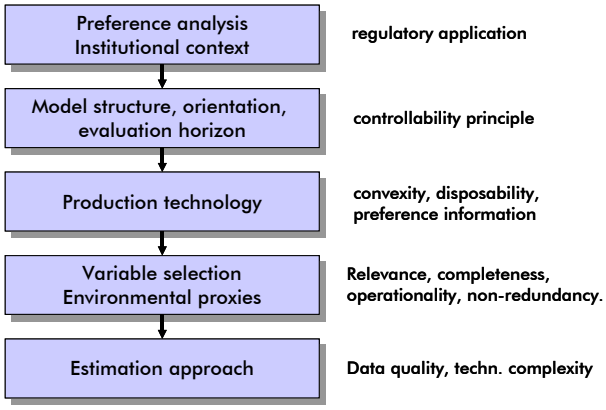
- Provide improvement targets through best practice based on a long-term robust specification.

Robustness

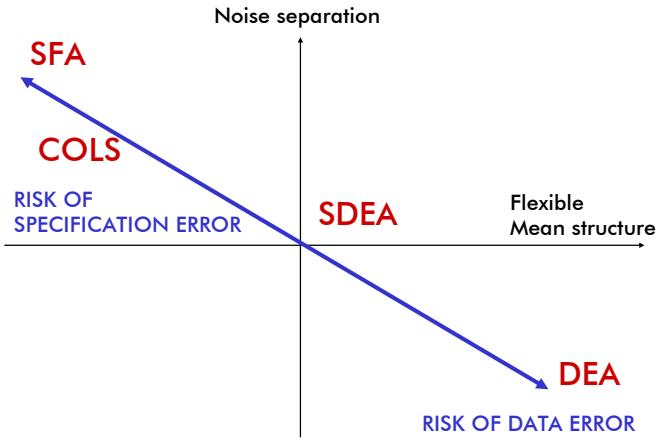
Robustness of efficiency estimates
- Invariance of estimates to stochastic influences

Robustness of model specification
- Invariance to changes in accounting reporting standards
- Invariance to changes in operating standards
- Invariance to changes in financing policy

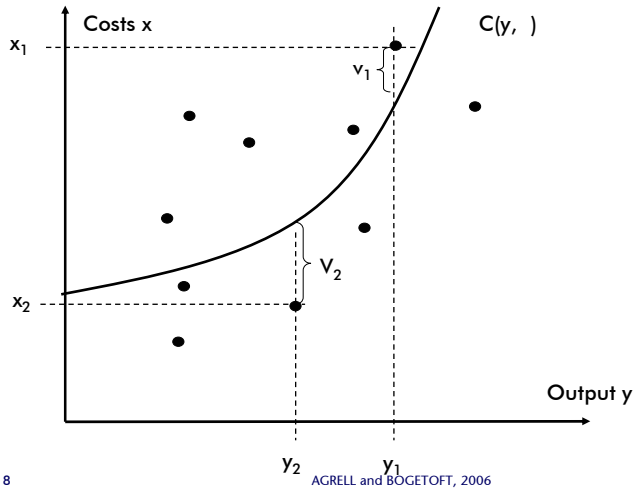
Process



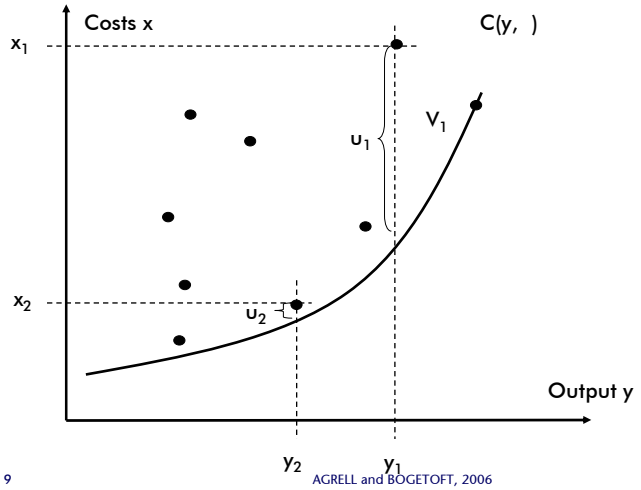
Tradeoffs



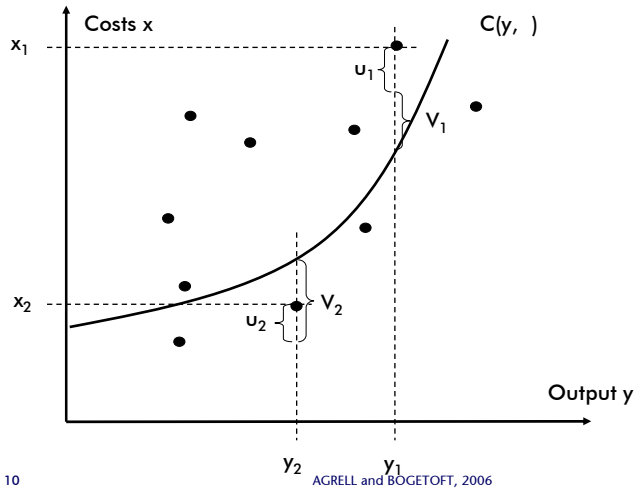
Average (OLS)



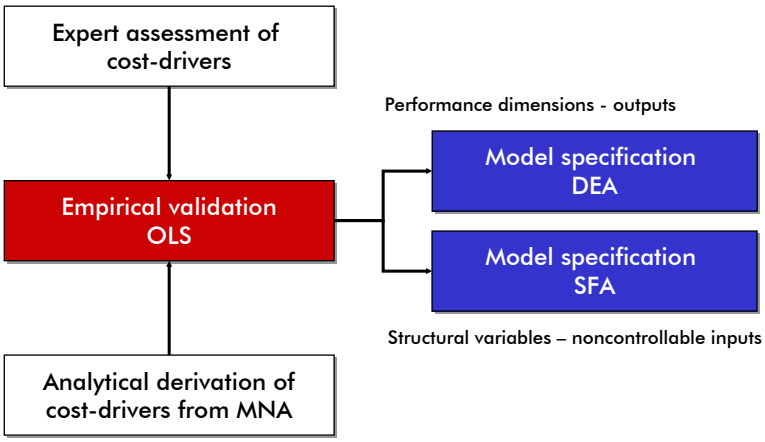
Deterministic frontier



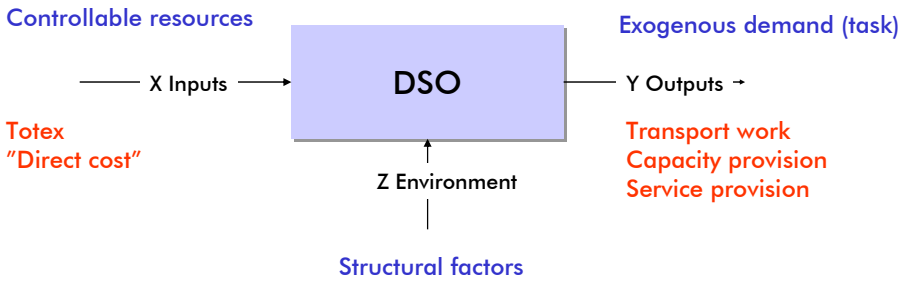
SFA



Primary variable selection



Model structure



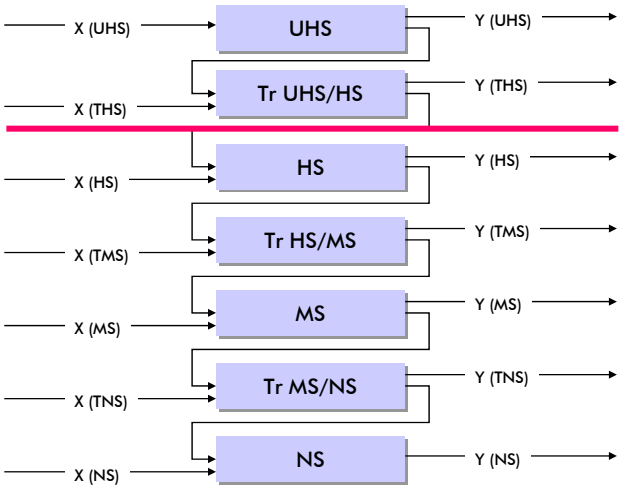
Environmental factors under test

Structural factors
- Urbanization
  - zArea.city, zArea.green, zArea.industry
- Soil type
  - zSoil.0, zSoil.1, zSoil.2, zSoil.3
- Topology
  - zSlope, zHeight.average, zHeight.diff
- Asset age
  - zAge
- Location
  - East/West

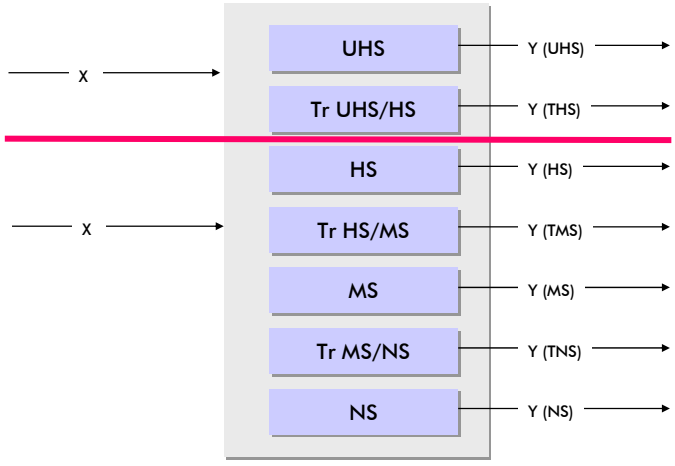
Estimation approach

1. Costs C(X) — Resources X
2. Resources X(Y) — Delivery task Y
3. Costs C(Y) — Delivery task Y
4. Costs C(Y|Z) — Delivery task Y, Environment Z

Separable model



Integrated model



Challenges

Data validation….
- Reporting (units, scope, omitted values)

Capital expenditure
- Activation policy
- Depreciation policy
- East/West

Age effects
- Investment cycle effects on book value

Environmental variables
- Definition, access, data collection

Time…

Capital cost approach

Problem:
- The incumbent inefficiency in grid asset valuation (capex) is driven by past investments
- Reductions require reassesment of assets

Bottom-up approach:
- Nominal investment stream 1955-2004
  - Lines, cables, TS equipment, DS equipment
- Real annuities for electricity sample (223 DMU)
- PPI adjustment 1955-2004
- Technical lifelengths 40, 45, 50 years
- Real interest rate

Testing
- Second-stage on SFA and DEA scores
- Parallel tests for "real" TOTEX in DEA-SFA

Age effect approach

Problem:

- Accounting measures (investment cycle) give bias in favour of older networks in capex
- Operating cost may have an age bias in favour of newer grids

Age proxies

- Creation of economically weighted age proxies for electricity data based on 4 asset categories.
- Creation of physically weighted age proxies for gas pipelines.

Testing

- Second-stage on SFA and DEA scores
- Candidate for structural variable (Z) in OLS

Electricity data sets

	Available DMU	1st Validated DMU
Ultra high- voltage level (UHS)	5	
High-voltage level (HS)	96	38
Medium-voltage level (MS)	853	327
Low-voltage level (NS)	886	328
Ultra high-voltage level/high-voltage level (TrUHS/HS)	18	
High-voltage level/medium-voltage level (Tr HS/MS)	184	78
Medium-voltage level/low-voltage level (Tr MS/NS)	862	327

Gas data sets

	Available DMU	1st Validated DMU
High Pressure (HD)	616	563
Medium Pressure (MD)	648	605
Low Pressure (NS)	595	549

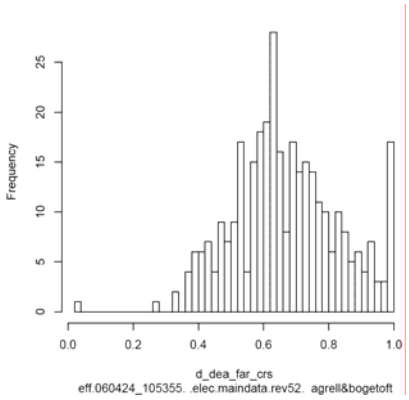
Electricity results (Ongoing)

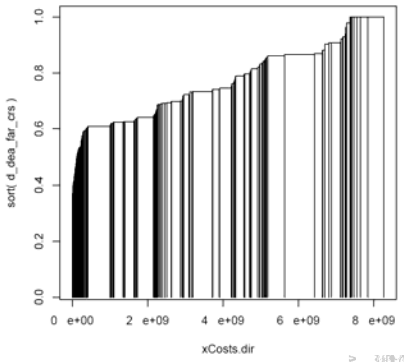
Joint electricity model

Input
- Total costs (xCostDIR)

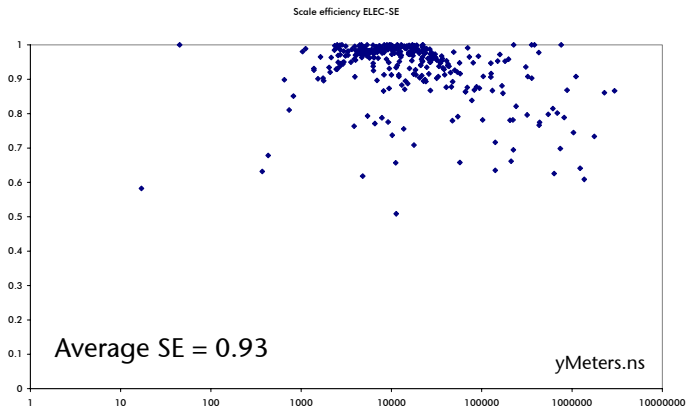
Output
- Service provision
  - yMeters.hs, yMeters.ms, yMeters.ns
  - yArea.hs, yArea.ms, yArea.1.ns
- Capacity provision
  - yPeakload.hs, yPeakload.ms, yPeakload.ns, yPeakload.hs_ms, yPeakload.ms_ns,
  - yDg.power.hs, yDg.power.ms, yDg.power.ns
- Transportation work
  - yEnergy.del.hs

Results ELEC – DEA(CRS)

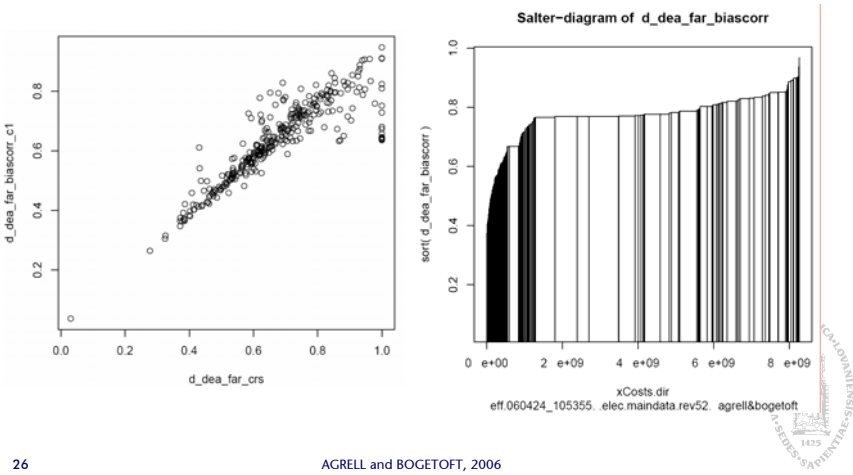




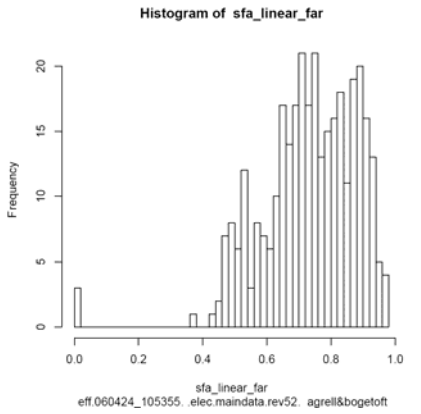
Scale efficiency ELEC-SE

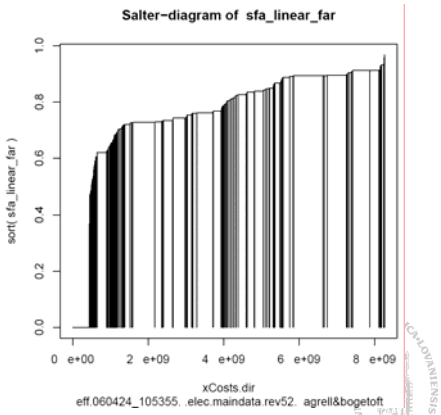


Biascorrected results ELEC-DEA

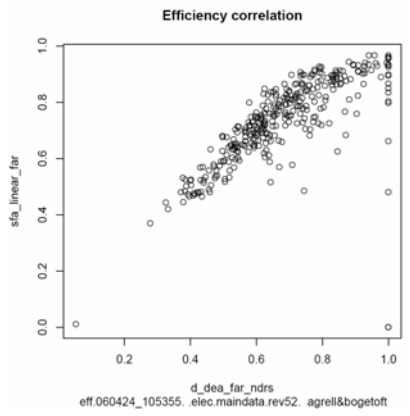


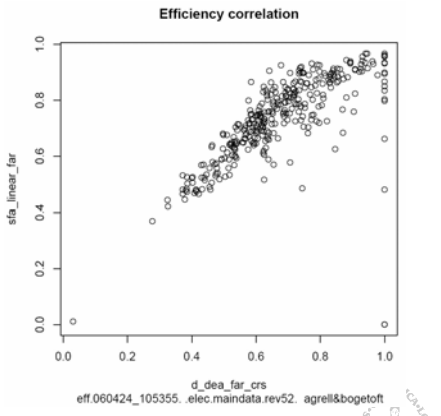
Results ELEC-SFA





Model consistency SFA-DEA (NDRS/CRS)



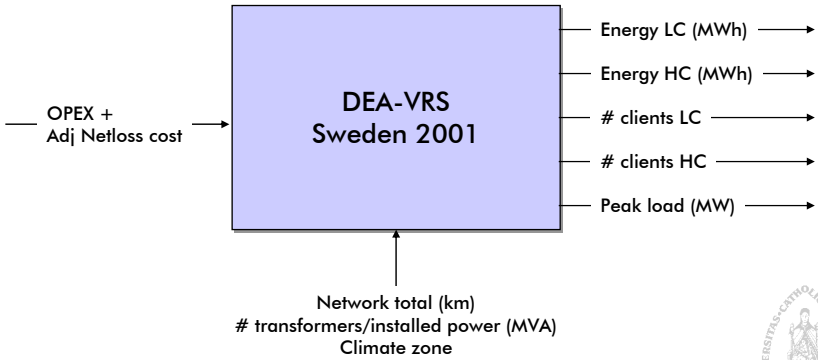


Rank order correlation =

Correlation ELEC

PEARSON	d_dea_far_vrs	d_dea_far_drs	d_dea_far_ndrs	d_dea_far_crs	d_dea_far_biascorr	d_dea_far_biascorr_c1	d_dea_far_biascorr_c2	sfa_linear_far
d_dea_far_vrs	1.00	0.99	0.91	0.90	0.96	0.89	1.00	0.66
d_dea_far_drs	0.99	1.00	0.88	0.91	0.95	0.88	0.99	0.64
d_dea_far_ndrs	0.91	0.88	1.00	0.98	0.92	0.88	0.91	0.71
d_dea_far_crs	0.90	0.91	0.98	1.00	0.91	0.88	0.91	0.70
d_dea_far_biascorr	0.96	0.95	0.92	0.91	1.00	0.98	0.97	0.75
d_dea_far_biascorr_c1	0.89	0.88	0.88	0.88	0.98	1.00	0.90	0.78
d_dea_far_biascorr_c2	1.00	0.99	0.91	0.91	0.97	0.90	1.00	0.68
sfa_linear_far	0.66	0.64	0.71	0.70	0.75	0.78	0.68	1.00

International comparison

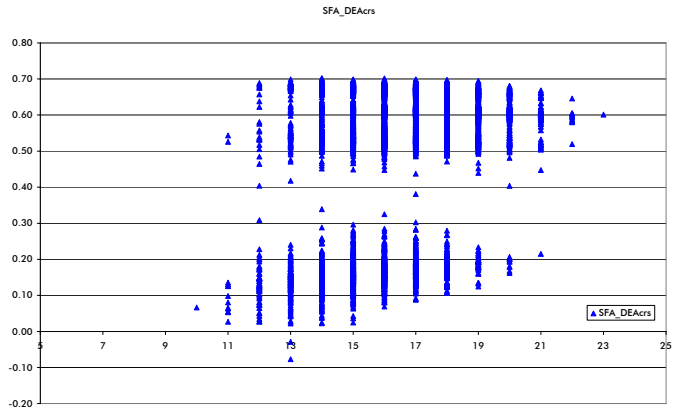


Correlation in Sweden 2001

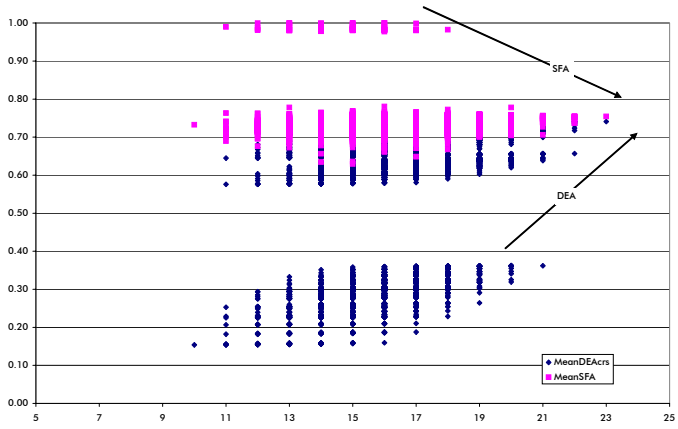
PEARSON Sweden 2001 data

	fdh	dea.vrs	sup.dea.vrs	dea.vrs. bias.corr	dea.vrs. biascorr.c1	dea.vrs. biascorr.c2	orderm	sfa. linear
fdh	1.00	0.59	0.40	0.60	0.60	0.59	0.84	0.26
dea.vrs	0.59	1.00	0.78	0.99	0.95	1.00	0.57	0.43
sup.dea.vrs	0.40	0.78	1.00	0.72	0.65	0.78	0.37	0.24
dea.vrs. bias.corr	0.60	0.99	0.72	1.00	0.99	0.99	0.59	0.41
dea.vrs. biascorr.c1	0.60	0.95	0.65	0.99	1.00	0.95	0.59	0.40
dea.vrs. biascorr.c2	0.59	1.00	0.78	0.99	0.95	1.00	0.57	0.43
orderm	0.84	0.57	0.37	0.59	0.59	0.57	1.00	0.27
sfa. linear	0.26	0.43	0.24	0.41	0.40	0.43	0.27	1.00

Dimensionality and model correlation ELEC



Dimensionality and average scores ELEC



Conclusions

German electricity reform relies on benchmarking models
- Structured, but intensive, model specification phase
- Strict application of exogeneity principle for controllability
- Large data sets, but data validation is paramount…
- Intention to work on integrated models for consistency with regulation

Preliminary results
- Joint model development assures techno-economical feasibility
- Already conceptually reasonable and statistically stable models in electricity
- Model results as good as incumbent models in other countries
- Considerable possibilities to refine data and models

Challenges include
- Potential future reconstruction of the capital expenditure investigated
- Age effects, investment cycles, still unclear impact
- Urbanization and connection potential in gas may need more work